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ROYAL AIRCRAFT ESTABLISHMENT

FARNBOROUGH, HANTS

TECHNICAL NOTE No: ARM. 407

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LUBRICATION OF CLOCKWORK FUZE MECHANISMS FOR BOMBS

by

F. HOWICK

Dec 78

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Technical Note No. Arm.407

December, 1948

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Lubrication of Clockwork Fuze Mechanisms for Bombs

by

F. Howick

R.A.E. Ref: Arm.S.1426/RRG/FH/31

SUMMARY

Tests of the value of mineral and non-mineral oils, silicone fluids and greases, and colloidal graphite as lubricants for clockwork fuze movements are described. The work has particular reference to the efficacy of the various lubricants under extremes of temperature. Some tests with no lubricant are recorded.

It is concluded that silicone fluids and greases are at present the most suitable for aircraft bomb fuze requirements.

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1 Introduction

Failures which occurred with flare fuzes, e.g. the M.III (American) during the war years, were shown to be due in part to the lubricant. This deteriorated during storage, especially at high temperatures and failed when called upon to function at extreme low temperatures. The object of this Note is to collect and record the results of the experimental work carried out on lubrication of fuze mechanisms for adverse conditions.

2 Method of Test

The value of a lubricant as such was assessed by comparison with the best of the non-mineral types of oil such as Ezra Kelley oil used by watchmakers for over a century. Tests were carried out with two types of movement. The first was an ordinary 2" drum lever movement as used in British flare fuzes, the balance giving 4 beats per second, capable of running for 30 hrs. with one winding. Points to be lubricated included low and high pressures with inverse high and low speeds. The balance included a static condition between each beat with rapid acceleration and deceleration. In contrast, the second, the American M.III fuze movement, had a range of 6 - 92 seconds and an escapement speed of 196 beats per second. An essential requirement of this movement was its capacity to self start. (All the American flare fuzes had the same basic clockwork mechanism).

Running tests were confined to the 2" drum type as above and preparation of the test movement involved reducing friction to a minimum and ensuring uniformity of balance wheel performance. The balance wheel arc would naturally diminish at the end of a 24 hr. run and would be further diminished by deterioration of the lubricant, until failure to complete a 24 hr. period occurred. Movements were placed in sealed canisters for both high and low temperature tests. Early tests at high temperature comprised a 24 hr. period at +60°C. This time was later increased to 48 hrs. 140°F

With the M.III fuze movement deterioration of the lubricant would soon cause failure due to the heavy loading at the pressure points, especially the escapement, where pressure for impulsing the balance is by point contact. For assessing the value of a new lubricant, movements, usually 12 in number, were chosen with known records, and a timing datum provided by runs at normal temperature. Cleansing was effected with petroleum ether with separate rinsing, and if not provided, countersinks made for the terminals of the bearing pivots. Care was taken to avoid over-lubrication which would defeat the object of the provision of these countersinks.

The tests made with colloidal graphite required preliminary preparation of the bearing surfaces by smoothing, further smoothing of the graphite after its application being done with peg wood. Main springs were best treated with Alcohol Resin dispersion.

Silicone fluids and greases were treated in the same way as normal lubricants.

3 Results

3.1 Non-Mineral Oils

Tests with non-mineral oils on both the American and the British mechanisms established their unreliability at low temperatures. Satisfactory functioning below -30°C was rarely obtained and -20° represented

the lowest temperature at which functioning could be relied upon.

3.2 Mineral Oils

As a result of the failure of non-mineral oils the Americans in early 1944 changed to a mineral oil WS.429. This lowered the temperature limit to about -50°C but introduced difficulties due to creeping and gumming on storage. These effects become extremely pronounced under tropical conditions. Creeping was countered by the use of a liberal application of the lubricant. Work directed to finding a mineral oil lubricant for British fuze mechanisms led to similar results, the oil DTD.44/D being finally chosen. The tendency to creep was overcome by the use of a 'non-spread dope'. Evaporation and gumming under prolonged high temperature storage still remained a problem but the rapidity of fuze expenditure under wartime conditions permitted it to be temporarily shelved.

3.3 Silicone Fluid and Grease

A comparative running test over considerable periods, showed that as a lubricant silicone fluids did not compare favourably with conventional lubricating oils. Their stability and small viscosity change at high and low temperature were however remarkable, and they gave reliable low temperature operation to -50° to -55°C. Silicone grease DC.33 had equally valuable properties. The inferior lubricating qualities were not considered to be detrimental for the 'once only' run required of fuze mechanisms at the time of their expenditure.

Particulars of these tests are given in Appendices I and II.

3.4 Colloidal Graphite

Clock parts prepared as shown on Fig.1 were subjected to a continuous running test. Satisfactory results down to below -70°C were obtained,but the performance of colloidal graphite as a lubricant at normal temperatures is inferior to that of any of the fluid lubricants tested. Detailed results of the tests appear in Appendix III.

3.5 Lubrication Absent

Tests with degreased and unlubricated M.III fuzes established their unreliable performance in this condition. Results of this test appear in Appendix I (Table I).

4 Conclusions

The effective low temperature range of the non-mineral types of lubricants is limited to approximately -20°C. They have good lubricating and staying qualities.

The mineral types Nos.8, 9, 10 and 11 (see Appendix IV) represent substitutes for the usual watch and clock oils with slightly lower temperature limits. There is a great liability to creep as viscosity diminishes, with earlier gumming.

Nos.6 and 7 are spreading types with gummy residue after evaporation.

No.5 is the best general low temperature lubricant, its low temperature limit being approximately -45°C to -50°C. Its liability to spread and evaporate limits its usefulness.

Colloidal graphite can only be applied where the bearing surface is sufficiently generous. Point contact as for balance wheel bearings of the 2" drum clockwork movement, or scape wheel to pallet of the M.III being equivalent to no lubricant, as it would scrape off in action. In the tests the balance pivots were oiled for the continuous running test at normal temperature, and the normal coating gave best results.

Note: The German No.17, long delay clockwork fuze had an appreciable thickness of graphite on the scape wheel teeth, but in order to lessen friction, hardened and polished steel inserts were included for pivot bearings. With these refinements its 84 hr. run appeared to be satisfactory.

Silicone Fluids and Greases cover a wide range of viscosities and advantage can be taken of this fact to suit a particular requirement. The range from 500/50 C.S. to 500/200/C.S. was found to be most suitable. Where a higher viscosity was required, as for mainsprings, etc. Silicone Grease D.33 is satisfactory.

Any tendency to creep with the lower viscosities can be countered by the use of non-spread dope, and no incompatibility has been observed.

Attached:-

Fig.1 Drg. Arm.55524.

Appendices I - IV.

Advance Distribution:-

DArmRD
ADArmR
ADArmRD
RDArm5
RDArmR2
RDInstA
Sec. OB - 2
CEAD
CSAR
TPA3/TIB - 60
DRAE
DDRAE(W)
IAP Dept. (Mr. Honick)
Chem. Dept. (Mr. Atkinson)
Arm. Dept. - 10
Library - 2

APPENDIX I

Tests on Fuze M.III A.II lubricated with Fluid Silicones

(Test Record No.1019 dated 14 Jan.1947)

Introduction

The M.III fuze was originally lubricated with porpoise jaw oil (Grade 1 watch oil U.S. Spec.2-47), but in January, 1944, the lubrication was changed to a mineral oil (W.S.429 manufactured by the Standard Oil Co. and conforming to U.S. Spec. ANO.4).

Fuzes lubricated with Grade 1 watch oil were found to function satisfactorily down to a temperature of -35°C (Test Record No.F85). Although the use of mineral oil gave a slightly lower temperature for reliable operation, it was found that the lubricant crept and evaporated during tropical storage, causing the fuze to fail.

Efforts have therefore been made to find a lubricating fluid to enable the fuze to withstand prolonged tropical storage and subsequently to function satisfactorily at a low temperature. The fluids investigated in these tests are a series of fluid Silicones manufactured by Messrs. Dow Corning. These fluids, obtainable in a range of viscosities, are very involatile and their viscosity does not change greatly over a wide range of temperature.

Object of Tests

1 To determine if lubricant is necessary for the fuze.

2 To investigate the performance of the fuze at low temperature when lubricated with fluid silicones and to compare the results with a fuze lubricated with mineral oil.

3 To investigate the performance of the fuze at low temperature after prolonged storage at 70°C when lubricated with fluid silicones.

Methods of Test

1 Six fuzes were degreased and tested at normal temperature with a setting of 92 seconds. The results are given in Table I.

2 Eighteen fuzes remaining from the batch of forty eight tested in June, 1945, (Test Record F156) were dismantled and degreased with petroleum ether. Attention was given to the pivots and bearings to ensure smoothness. Countersinks were provided for the lubricant and nonspread dope was applied to the adjacent parts.

Sixteen of the fuzes in groups of four were lubricated with Dow Corning silicone fluids of four viscosities, viz. 350, 200, 100 and 50 Centistokes. The mainsprings were treated with colloidal graphite in a resin-alcohol dispersion. The remaining two fuzes were lubricated throughout with mineral oil to DTD.44D.

Three timing tests with the fuzes set to a nominal 92 seconds delay were made at normal temperature (20°C) and the mean of the three tests for each fuze was used as the value for the determination of the errors in subsequent tests. The results are given in Table II, Tests Nos. 1, 2 and 3. The fuzes were placed in an oven at 70°C for 48 hours. They were then taken out and placed in a refrigerator, the fuzes being maintained at the stated temperature for at least two hours, preceded by 16 hours at -52°C. After being taken from the refrigerator, the

fuzes were immediately timed at laboratory temperature with an accurate stop watch. The results of the tests at -60°C, -53°C and -50°C are given in Table II Tests Nos. 4, 5 and 6.

3 The fuzes were placed in an oven maintained at a temperature of 72° to 74°C during working hours. During other hours the oven was switched off. The six weeks period of storage was made up as follows:-

2	periods	of	48	hours	at	high	temperature
2	"	"	24	"	"	"	"
26	"	"	8	"	"	"	"
6	"	"	3	"	"	"	"
	Total		370				

After removal from the oven, the fuzes were placed in a refrigerator and tested at a temperature of -60°C. The results are given in Table II Test No.7.

4 Twelve of the fuzes were dismantled, the lubrication of the main-springs changed from colloidal graphite to Dow Corning Silicone Grease D33, the mechanism lubricated again with the silicone fluids and a test made at -60°C. The results are given in Table II Test No.8.

Conclusions

Of the six fuzes tested without lubrication, three stopped after a few seconds on the first test, whilst the remainder failed after several tests. Lubrication is therefore essential to the fuze.

The use of fluid silicones instead of oil greatly improves the performance of the fuze as comparison of Table II with Tables I and II of Test Record No. F156 will show. After a prolonged tropical test, the fuze is still capable of functioning correctly at -60°C, the lowest temperature at which the tests were made, when lubricated with Dow Corning fluid silicones Type 500 of viscosities 200, 100 or 50 Centistokes.

The lubricating property of fluid silicones being less than oils, it is considered advisable that all sliding surfaces such as pivots, etc. be made as smooth as possible. Further tests are being made with fuzes lubricated with silicone grease which has the advantage that the application of nonspread dope to the mechanisms is not necessary.

TABLE I

Timing Tests on Fuze M.III A.II without lubricant

All fuzes tested at max. setting of 92 secs. and at normal temperature

Fuze No.	Time in secs. from release of clockwork to firing
1	Started and stopped after about 15 secs.
2	" " " " " 5 "
3	" " " " " 2 "
4	92.4, 93.6, started and stopped after about 15 secs. on third test.
5	90.6, 91.0, 90.6, 90.6, 91.0, 91,2, 91.4, 91.4. Started and stopped after about 5 secs. on ninth test.
6	92.6, 92.4, 92.2, 93.0, 92.8, 93.6. Started and stopped after about 1 sec. on seventh test.

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TABLE II

Fuze M.III A.II Lot F.A. - 73 - 40. G.T.I. Timing test with Lubrication

Delay setting 92 secs. nominal

Temperature Test No.	Normal (20° approx.) 1 Time	2 Time	3 Time	Mean Time	-60°C 4 Error	-55°C 5 Error	-50°C 6 Error	-60°C 7 Error	-60°C 8 Error	Lubricating Fluid Type	Type No.	Viscosity Centistokes
Fuze No. 1	90.4	90.6	90.6	90.6	**/	**	-1.2	**/	NT	Fluid Silicone	200	350
2	91.2	91.0	91.0	91.0	**	**	-0.8	**	NT	" "	"	"
3	90.0	90.4	90.2	90.2	**	**	-1.2	**	NT	" "	"	"
4	91.0	91.4	91.2	91.2	-2.6	-2.4	-2.4	**	NT	" "	"	"
5	93.0	93.4	93.8	93.4	-2.2	-1.8	-1.2	-1.6/	-1.4/	" "	500	200
8	92.0	92.4/	91.6	92.4	-2.0	-2.0	-1.2	-1.6	-1.6	" "	"	"
9	91.8	92.0	91.4	91.6	-2.0	-1.6	-2.0	-2.0	-2.0	" "	"	"
10	90.6	91.0	90.6	90.8	-1.2	-1.4	-0.8	-1.4	-1.4	" "	"	"
11	92.0	91.6	91.2	91.6	-2.2	-2.0	-0.67/	-1.8	-1.8	" "	500	100
13	91.4	91.2	91.2	91.2	-2.2	-2.0	-1.4	-1.6	-1.8/	" "	"	"
20	90.4///	90.2/	90.4	90.4	-2.4///	-2.2	-2.0/	-1.6	-2.0	" "	"	"
42	92.0	92.0	90.2	92.0	-2.0	-1.6	-1.4	-1.8	-1.6	" "	"	"
43	91.8	91.2	90.8	91.4	-1.6	-1.4	-1.4	-1.8	-1.6/	" "	500	50
44	89.6	89.2	89.4	89.4	-1.4	-1.0	-1.0	-1.4	-1.6	" "	"	"
45	90.8	90.8	91.4	91.0	-2.2	-2.0	-1.4	-1.6	-1.6	" "	"	"
46	90.4	90.4	90.6	90.4	-1.4	-1.0	-1.4/	-1.6	-2.4	" "	"	"
47	91.4	91.6	91.8	91.6	**/	**	**	**	NT	Lubricating oil DTD.44/D		
48	92.8	92.6	92.6/	92.6	**	**	+3.4	**	NT	"	"	"

NT = No test made. ** = Mechanism did not run. / = Faulty detent ejection.
In Tests Nos. 1 to 7 the mainsprings of Fuzes 1 to 46 lubricated with colloidal graphite applied in a resin alcohol dispersion.
In test No.8 the mainsprings of Fuzes 1 to 46 lubricated with Dow Corning Silicone Grease D33.
- sign indicates firing at a time less than the mean time (Col.5).
+ sign indicates firing at a time greater than the mean time (Col.5).
All times are in seconds.

APPENDIX II

Fuze M.III. A.II Lubrication with Silicone Grease
(Test Record No. 1026 dated 16 May, 1947)

Introduction

The requirement of Bomb Group, Arm. Dept. R.A.E. for a supply of 30 fuzes to give reliable operation at -50°C, has yielded results which are considered to be of sufficient interest to be presented in the form of a Test Record.

The performance of Silicone Fluids as lubricants is given in Test Record No.1019 (14th January, 1947) issued previously. Subsequent tests with Silicone Grease D.33 have given good low temperature results and its use makes the application of non-spread dope unnecessary. The two sources of manufacture of Fuze M.III are G.T.I. and W.C.Co. and previous tests have been made with G.T.I. as being more reliable, but those available at present are of W.C.Co's manufacture and were used for the test. To improve self starting it was necessary to hand finish the working surfaces, and to lessen the likelihood of failure of the starting detent to eject by its being held in position by the slot in the timing disc, its hook (provided to jerk the clockwork into action) was reduced in height by approximately one half.

Object of Test

To provide 30 fuzes M.III A.II 5-92 sec. delay for Bomb Tail Smoke Generator, to function at -50°C.

Method

To provide a means of examining the clockwork escapement in action, it was necessary to provide sighting holes as in fuzes of G.T.I. manufacture, and to assist in self starting, the working surfaces were finished smooth.

The lubricant was applied very sparingly during assembly.

Timing was at longest delay of 92 seconds with errors on the + side as the tendency is to gain at low temperature.

The refrigerator being used at night gave at least 12 hrs. at the test temperature before timing the fuzes, the temperatures used being -63°C, -57°C and -53°C. Doubtful fuzes, after adjustment, were given a final test at -59°C. Fuzes Nos.9 and 19 were rejected, the former being replaced by x (included for emergency) and No.19 by a fuze from a previous test on Silicone Fluid 500/100 cs marked (5). This was used and tested as shown without alteration.

Results

For the purpose required the results are quite satisfactory. A comparison of the results obtained by the use of Silicone Grease as against Silicone Fluids would require a further test using identical fuzes.

Conclusions

The provision of sufficient mainspring torque to ensure self-starting - without resorting to the hooked detent - would assist at low temperature, where any slight resistance due to increased viscosity of the lubricant could be sufficient to hold up the mechanism.

TABLE I

Fuze M.III A.II Lot P.A. - 73-52. W.C.Co. 4-44 Mech. Time 5 - 92 Sec. delay

Delay Setting 92 sec. nominal

Timing Test with Lubrication

Test No. Temp. Fuze No.	1 Normal 20° approx.	2 -63°C	Difference from Test No.1	3 -57°C	Difference from Test No.1	4 -53°C	Difference from Test No.1	5 Normal	Difference from Test No.1	6 -59°C after adjustment	Difference from Test No.1	
1	92.8	93.4	+0.6	92.0	-0.8	91.6	-1.2	92.4	-0.4			O.K.
2	92.2	90.8	-1.4	91.2	-1.0	91.2	-1.0	92.4	+0.2			O.K.
3	92.4	x 2 min.		x 3 min.		x 5 min.		91.2	-1.0	92.0	-0.4	O.K.
4	92.6	x 3 "		x 3 "		92.0	-0.6	92.4	-0.2	91.2	-1.4	O.K.
5	92.4	x 4 "		92.4	0.0	92.6	+0.2	92.4	0.0			O.K.
6	92.2	x 8 "		x 15 min.		92.4	+0.2	92.2	0.0	92.4	+0.2	O.K.
7	93.0	x 6 "		x 4 "		92.0	-1.0	93.2	+0.2	93.0	0.0	O.K.
8	92.6	98.0	+5.4	90.8	-1.8	90.8	-1.8	91.8	-0.8			O.K.
9	92.2	x 3 min.		x 5 min.		x 4 min.		92.4	+0.2	x 6 min.		Rejected
10	92.2	89.8	-2.4	91.0	-1.2	90.2	-2.0	91.4	-0.8			O.K.
11	93.0	x 8 min.		110.0	+17.0	91.6	-1.4	92.0	-1.0	91.2	-1.8	O.K.
12	93.0	91.4	-1.6	91.4	-1.6	92.0	-1.0	92.6	-0.4			O.K.
13	92.0	91.0	-1.0	89.8	-2.2	89.8	-2.2	90.4	-1.6			O.K.
14	92.6	x 10 min.		x 6 min.		x 20 min.		92.8	+0.2	92.8	+0.8	O.K.
15	92.6	x 23 min.		x 8 min.		91.0	-1.6	92.6	0.0	90.4	-2.2	O.K.

x = prolonged firing time, mostly due to delayed starting

\- sign indicates firing at a time less than firing time at normal temperature Test No.1

\+ " " " " " " greater " " " " " " " "

All times are in seconds.

TABLE I (Continued)

Test No. Temp. Fuze No.	1 Normal 20° approx.	2 -63°C	Difference from Test No.1	3 -57°C	Difference from Test No.1	4 -53°C	Difference from Test No.1	5 Normal	Difference from Test No.1	6 -59°C after adjustment	Difference from Test No.1	
16	92.8	100.0	+7.2	90.0	-2.8	90.0	-2.8	91.8	-1.0			O.K.
17	92.8	90.0	-2.8	90.8	-2.0	90.4	-2.4	92.4	-0.4			O.K.
18	92.2	93.2	+1.0	93.0	+0.8	93.0	+1.0	91.6	-0.6			O.K.
19	92.0	x 14 min.		x 10 min.		x 15 min.		91.4	-0.6	x 15 min.		Rejected
20	92.4	x 16 "		105.0	+12.6	92.0	-0.4	92.0	-0.4	92.2	-0.2	O.K.
21	92.4	92.0	-0.4	91.8	-0.6	91.8	-0.6	92.0	-0.4			O.K.
22	92.0	x 15 min.		92.0	0.0	92.4	+0.4	91.4	-0.6	92.4	+0.4	O.K.
23	92.6	x 20 min.		92.0	-0.6	91.2	-1.4	91.6	-1.0	91.0	+1.6	O.K.
24	92.2	90.2	-2.0	92.0	-0.2	91.6	-0.6	92.2	0.0			O.K.
25	92.8	x 3 min.		91.8	-1.0	90.2	-2.6	92.2	-0.6			O.K.
26	93.0	91.0	-2.0	91.0	-2.0	91.6	-1.4	92.4	-0.6			O.K.
27	93.0	90.4	-2.6	91.8	-1.2	90.6	-2.4	92.6	-0.4			O.K.
28	93.0	92.2	-0.8	92.2	-0.8	91.8	-1.2	92.4	-0.6			O.K.
29	92.4	91.8	-0.6	91.6	-0.8	92.0	+0.4	93.0	+0.6			O.K.
30	92.4	92.0	-0.4	92.4	0.0	91.6	-0.8	92.4	0.0			O.K.
(x)	92.4	91.2	-1.2	90.8	-1.6	90.8	-1.6	92.0	-0.4			O.K.
(5)	93.0									92.4	-0.6	O.K.

(x) Replaces fuze No.9

(5) Replaces fuze No.19

APPENDIX III

Extracts from records of tests on Colloidal Graphite

"All bearing surfaces and gear teeth were treated with 'dag' colloidal graphite dispersed in industrial spirit to provide either a dry graphite film or an adsorbed film, whilst the spring strips were treated with a Resin/Alcohol dispersion which our experiments show is more suitable for this type of treatment than the other product".

"The parts were assembled, the balance wheel pivots were lubricated with Kelley clock oil and on 19th June, 1946 the movements were set running. The balance wheel pivot bearings were not lubricated with graphite, as the design was unsuitable for this lubricant. It was observed that the balance wheel arc was approximately 280°. At the end of 24 hours the movements were rewound. The rewinding was carried out daily, except at week-ends and any stoppage during the 24 hour test period noted.

The first movement to fail was No.15 which, after running 108 hours, would not complete a 24 hour run. Winding was continued and complete failure to run occurred after approximately three months.

The remainder of the mechanisms continued to run correctly for 24 hours, some with diminishing balance wheel arc and occasional failures, until after about four months on October 25th, 1946, Nos.1, 2, 12, 13 and 14, would not run for 24 hours. By December 12th 1946, after about six months test, Nos.4, 6, 8 and 11 also would not always run for 24 hours.

On January 10th 1947, after about seven months test, the position was that No.15 would not run, Nos.1, 2, 4, 6, 8, 11, 12, 13 and 14 would not complete 24 hours running, whilst the remaining five, i.e. Nos.3, 5, 7, 9 and 10 would generally run for 24 hours but their balance wheel arc was only about 180°.

The results show that a slightly better performance has been given by the normal coating (Nos.1 to 5 and 6 to 10) as compared with the adsorbed film (Nos.11 to 15). The difference in performance between Nos.1 to 5 and 6 to 10 is insufficient to justify the application of the coating to the gear wheel teeth and the pinions.

The results may be compared with movements lubricated with suitable oil from which reliable service for at least twelve months has been obtained. The movements in this test gave reliable service for about 30 to 50% only of this time.

For such purposes however as fuze mechanisms, where the total running time including testing is short, the performance might be regarded as satisfactory.

The coating of the mainsprings with 'dag' dispersed in a resin-alcohol solution proved very satisfactory. The surface remained intact and became more polished with continued use".

APPENDIX IV

List of Lubricating Oils, etc.

No.	Non-Mineral	Notes
1.	Ezra Kelley Watch or Clock Oil, New Bedford, Mass.	Porpoise Jaw
2.	W.F. Nye " " " " " " "	Porpoise Jaw substitute
3.	Allens, R.304. Stafford & Allen, London.	Blackfish head oil
4.	Allens R.427. " " "	" "

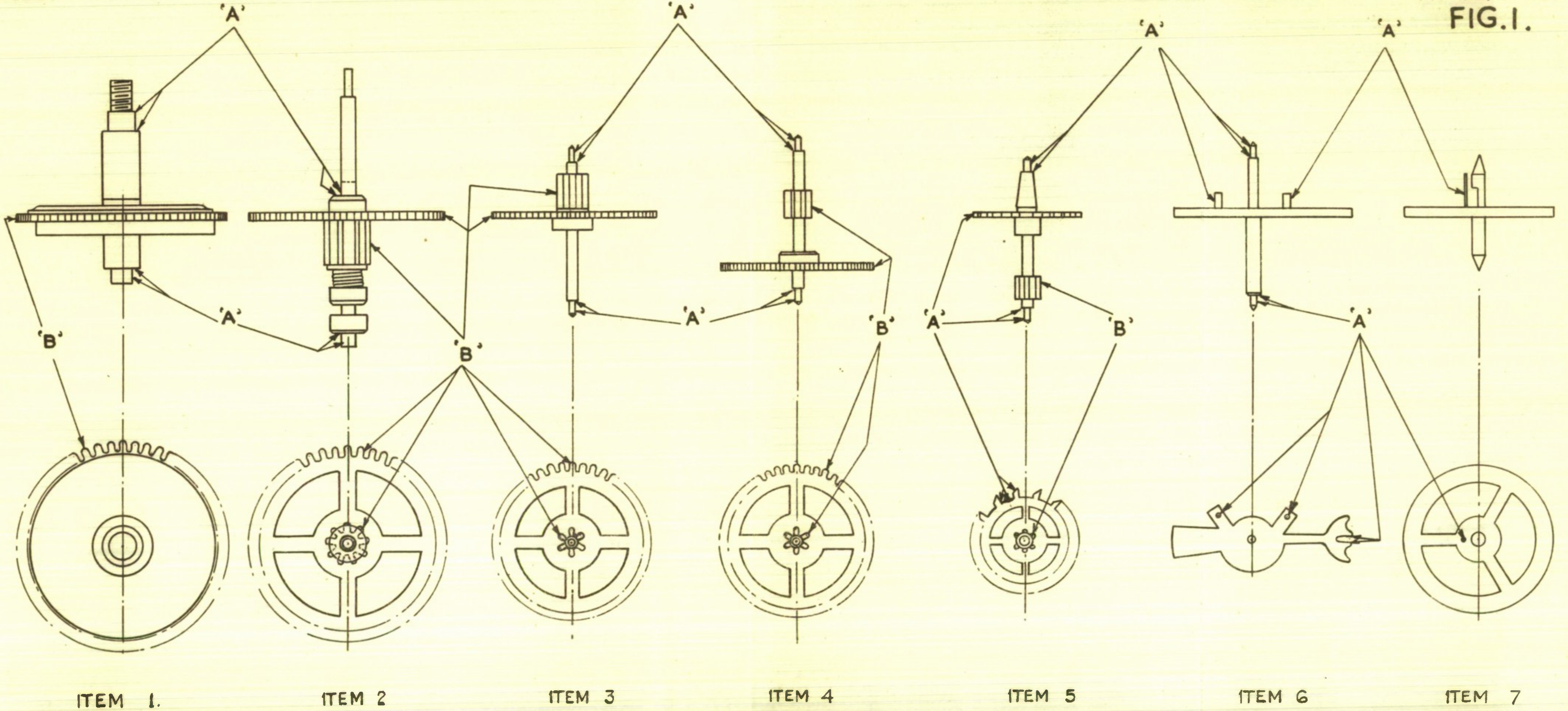
No.	Mineral		Notes
5.	D.T.D.44/D		Low Temperature
6.	W.S.429/A.N.04 Standard Oil Co. U.S.A.	Out of service as being corrosive	" "
7.	D.T.D.561 British equivalent of No.6.		
8.	W.S. Edgar Vaughan Commercial Type as used by contractors.		
9.	Z.1211 Alexander Duckham Commercial Type as used by contractors.		
10.	Mobius Hannover Commerical Type as used by contractors.		
11.	Intava 691. = D.T.D.8119 Commercial Type as used by contractors.		

No.	Silicone						Notes
12.	Silicone	Fluid	Type	200	350	C.S. Dow Corning	High and Low Temperature
13.	"	"	"	500	200	" " "	" "
14.	"	"	"	500	100	" " "	" "
15.	"	"	"	500	50	" " "	" "
16.	"	Grease D.C.33.					

No ARM. 55524

T.N. ARM 407

FIG. I.



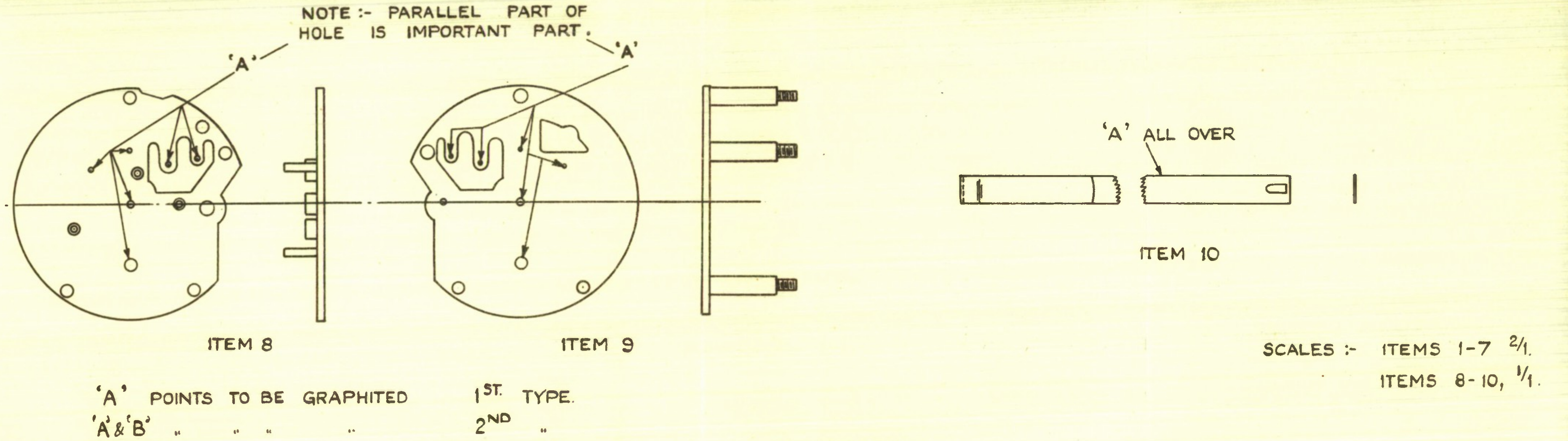


FIG.1. 2" DRUM MOVEMENT

PARTS TO BE GRAPHITED.

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AD#:
Date of Search: 13 February 2007

Record Summary:
Title: Lubrication of clockwork fuze mechanisms for bombs
Covering dates 1948
Availability Open Document, Open Description, Normal Closure before FOI Act: 30 years
Former reference (Department) TN ARM 407
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